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PRODUCTION OF 4 INCH DIAMETER TUBES.(U)
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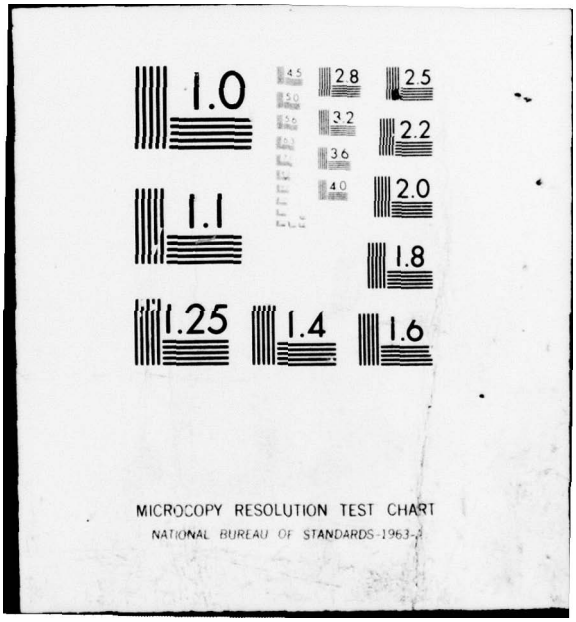
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LORY INDUSTRIES INCORPORATED

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(9) Final Technical Report

For Inch

(6) PRODUCTION OF 4" DIAMETER TUBES

LORY INDUSTRIES INCORPORATED

SUBMITTED TO:

U.S. Army Armament Research And Development Command

Picatinny Arsenal
Dover, New Jersey 07801

(15) Contract No. DAAK10-77-C-0093

(11) September 1, 1978

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John S. Lory - President

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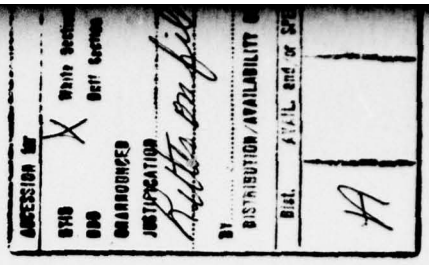

INTRODUCTION:

Current and future charge requirements which will necessitate use of nitrocellulose tubes are the 8 inch M188 155MM, M203 155MM, XM211 and the 155MM M119 weapons.

Of paramount interest in proposing spiral winding procedures for the production of igniter tubes is the promise of consistent quality in the fabricated items and cost effectiveness. The molding procedures currently employed to manufacture igniter tubes require substantial investment in capital equipment with production rates that are much lower than can be achieved by commercial tube winders.

The tube winding method proposed by Lory Industries for development utilizes nitrocellulose paper produced on commercial paper mill machinery. Therefore, the igniter tubes manufactured by commercial spiral winding techniques would be produced from a basic material with a promised uniformity and quality, made possible by decades of experience in the manufacture of commercial paper sheet products.

TECHNICAL SECTION:

There are two main areas of technical effort which must be addressed in accomplishing the tasks set forth in the Scope of Work delineated this contract.

1. Development of an economical production process by spiral wrapping for the fabrication of igniter tubes from energetic nitrocellulose paper.
2. Development of suitable adhesives or bonding agents that would be employed in the lamination procedures involved in spiral winding layers of energetic nitrocellulose paper into a finished tube product.

In the interest of making this report as brief as possible, we shall not

make more than a basic reference to the procedures involved in the manufacture of the nitrocellulose paper stock from which igniter tubes will be made. It should be sufficient to know that Lory Industries is at present, producing increment containers from flat sheet nitrocellulose paper stock. The nitrocellulose sheet stock utilized in the fabrication of increment containers is admittedly slightly different in formula than would be utilized to produce igniter tubes.

The basic material from which we fabricated the 4" tubes is manufactured on conventional paper making equipment by commercial or institutional facilities experienced in the production of high quality sheet paper stock. At the present time our main source of supply for the basic paper stock is the Herty Foundation of Savannah, Georgia. Herty has for many years been the only source of supply to the Government for special formulation nitrocellulose sheet stock.

A crash study was performed of available spiral winding tube machinery commercially produced and sold in the United States. A preliminary effort in this area has indicated that a number of manufacturers of this type of equipment are located within a 500 mile radius of New York City. The available equipment produced by these manufacturers was investigated and studied for flexibility to produce igniter tubes of varying diameters, reliable operation with unskilled or semi-skilled operators, ease of maintenance, high production rates and finally the degree of engineering assistance that may be available from the manufacturer in adapting his equipment to the production of spiral wound tubes made of the special materials required by the Government.

The selection of materials to be used with explosives, propellants, and similar high energy compounds is normally based on the physical properties required of the resulting system. However, the ability to use a given material with a given high energy compound is ultimately determined by the compatibility of the two within the resulting system. There are dual aspects of compatibility to consider: the effect of the materials on the high energy compound, and the effect

of the high energy compound on the materials. We are assured the composition formulation called for in the RFQ for the nitrocellulose sheet stock is of satisfactory compatibility, since it is presently employed in the manufacture of molded igniter tubes. However, the adhesives or binders which would be used to produce spiral wound igniter tubes, requires special consideration for compatibility.

The adhesive that we have developed, we believe, is ideally suited to this application. Any adhesive chosen to bind laminate layers of nitrocellulose paper must be fast drying. Fast drying can be accomplished by utilizing solvents with rapid evaporation rates. However, solvents of this type cannot be utilized in the fabrication of igniter tubes because they would tend to dissolve the nitrocellulose fibre. Therefore, adhesives had to be restricted to ones that could provide the necessary requirement of high strength bonding without altering the basic construction or composition of the laminate material.

The machinery depicted in Figure (1) is the type utilized to produce contract quantity tubes. The equipment includes material stands which are capable of holding five rolls of nitrocellulose paper. The paper is fed from the material stand to the rollers which pick up the adhesive from the reservoir and deposit the adhesive on one side of the nitrocellulose strip. The adhesive reservoir can be heated in the event that elevated temperatures are needed for the proper application of the adhesive. The individual slit strips of nitrocellulose paper are then precisely placed so that the three or four laminates which would make up the required wall thickness can be continuously placed on the mandril. Finally, the tube material is moved down to the automatic tube slicer which cuts off the tubes to the desired lengths.

Figure (2) shows the overlapping laminations that were provided in the fabricated tubes to produce the maximum rigidity and strength in manufactured tubes.

In fabricating delivery quantities called for on this contract an adhesive

produced by G & A Chemical Corp. of Nashville, Tennessee was utilized. This adhesive is designated as number 65X1094 by the manufacturer and is commercially available. Tests performed by Lory on burning rates and bonding strength proved this material to be well suited for spiral tube bonding.

We are certain that other adhesives form other manufacturers might also have application in the fabrication of igniter tubes, however, additional efforts in research will be required to perform more comprehensive evaluation of other adhesive candidates.

Originally, it was anticipated that a total of 600 pounds of nitrocellulose sheet stock would be sufficient to fabricate contract quantities of tubes and also to experiment with winding on equipment produced by four (4) other tube winding machinery producers. Unfortunately, in experimenting with various adhesive candidates we utilized more than the planned amount of sheet material. As a result, we were only able to deliver 64 of the 100 ordered tubes in the 28" length. Our invoice for the work performed has been adjusted to reflect delivery of the lesser quantity of 28" tubes. All other items in Scope of Work have been now delivered complete.

CONCLUSION:

Delivery of contract quantities of tubes should demonstrate the practicality of utilizing spiral wind techniques to tube production in the dimensions specified.

1. The spiral winding equipment used was manufactured by Paco Winders Inc. of Philadelphia, Penn.

2. Adhesive used to bond laminate layers of nitrocellulose sheet was purchased from G & A Chemical Corp. of Nashville, Tenn., and is identified as No. 65X1094.

3. Procedure for spiral winding is straightforward and requires no major modification of specified equipment.

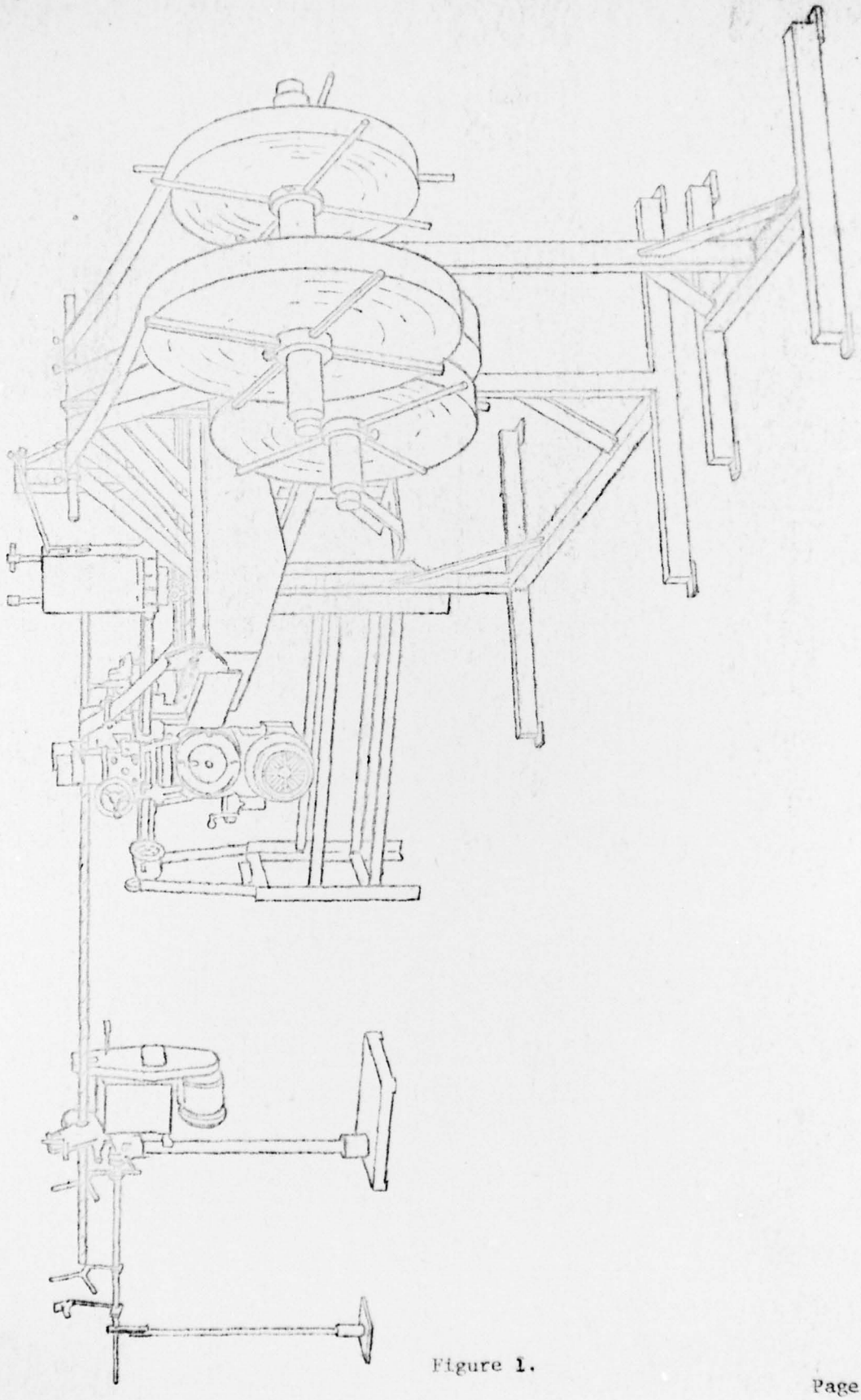

Figure 1.

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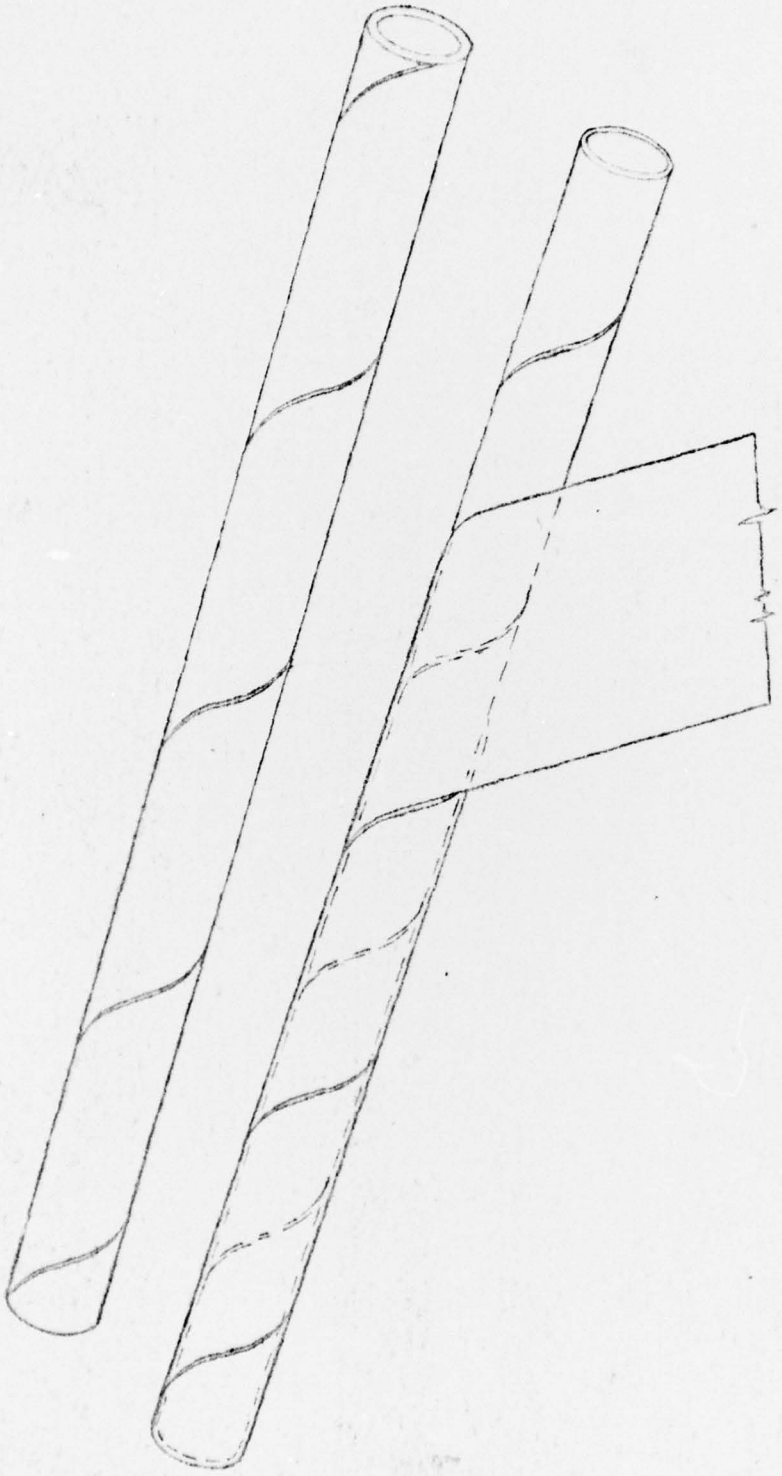

Figure 2